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(71) Applicant
000003986
Nissan Chemical Industry Co.
3-7-1 Kanda Nishiki-cho
Chiyoda-ku
Tokyo

(72) Inventors
K. Tamogami
c/o Nissan Chemical Industry Co.
Biosciences Laboratory
1470 Shiraoka
Shiraoka-machi
Minami Saitama-gun
Saitama-ken

T. Honda
c/o Nissan Chemical Industry Co.
3-7-1 Kanda Nishiki-cho
Chiyoda-ku
Tokyo

(74) Agents
T. Hanabusa, Patent Attorney
(plus 1 other)

(54) [Title of the Invention]

Agrochemical-coated unhulled rice seed

(57) [Abstract]

[Objective] Agrochemical-coated unhulled rice seed which enables the frequency of use of agrochemicals to be reduced

[Constitution] Agrochemical-coated unhulled rice seed which has been coated by means of an adhesive resin layer which contains agrochemical comprising one or more types of biocide, insecticide and/or plant growth regulator, together with optionally-added surfactants and/or inorganic auxiliaries.

[Scope of Claims]

[Claim 1] Agrochemical-coated unhulled rice seed which has been coated by means of an adhesive resin layer which contains agrochemical.

[Claim 2] Agrochemical-coated unhulled rice seed which has been coated by means of an adhesive resin layer which contains agrochemical and surfactant.

[Claim 3] Agrochemical-coated unhulled rice seed which has been coated by means of an adhesive resin layer which contains agrochemical and inorganic auxiliary.

[Claim 4] Agrochemical-coated unhulled rice seed which has been coated by means of an adhesive resin layer which contains agrochemical, surfactant and inorganic auxiliary.

[Claim 5] Agrochemical-coated unhulled rice seed according to any of Claims 1 to 4 where the agrochemical comprises one or more types of biocide, insecticide and/or plant growth regulator.

[Claim 6] Agrochemical-coated unhulled rice seed according to any of Claims 1 to 5 where the water solubility of the agrochemical active component is no more than 100 ppm at 20°C.

[Claim 7] Agrochemical-coated unhulled rice seed according to any of Claims 1 to 6 where the adhesive resin liquid for forming the adhesive resin layer comprises an aqueous emulsion of a water-insoluble synthetic resin.

[Claim 8] Agrochemical-coated unhulled rice seed according to any of Claims 2 and 4 to 7 where the surfactant is a synthetic surfactant.

[Claim 9] Agrochemical-coated unhulled rice seed according to any of Claims 3 to 8 where the inorganic auxiliary is clay or talc.

[Claim 10] A method for the production of agrochemical-coated unhulled rice seed which comprises coating unhulled rice seed by means of an adhesive resin liquid containing agrochemical and optionally-added surfactant and/or inorganic auxiliary, and then drying the coated layer formed by this coating.

[Detailed Description of the Invention]

[0001]

[Industrial Field of Application] The present invention relates to labour-savings in the cultivation of wetland rice. In particular, it provides agrochemical-coated unhulled rice seed, the use of which in the cultivation of wetland rice eliminates the need for the soaking and disinfection of the unhulled rice seed by means of agrochemicals which is carried out in order to prevent damage by disease and insects in the raising of the seedlings, the need for the spreading of granular agrochemicals or the sprinkling of liquid agrochemicals onto seedling boxes in order to prevent subsequent damage by disease and insects following transplantation, and the need for the application of agrochemicals to paddies in order to prevent damage by disease and insects following transplantation.

[0002]

[Prior Art and Problems to be Solved by the Invention]

(The current situation regarding the cultivation of wetland rice in Japan, and problems associated therewith) Methods for the cultivation of wetland rice are diverse and many different techniques are employed. The reason for this is because cultivation conditions are collectively employed which suit the topography of the region. In terms of measures aimed at reducing the costs of rice cultivation, as well as increasing paddy size and cooperative farming, considerable importance is also given to improving cultivation techniques, in particular reducing the manpower involved and the time taken for the

various operations performed starting with the seed disinfection up to transplantation.

[0003] Wetland cultivation methods are diverse and multi-faceted but broadly speaking they fall into the categories of ① raising seedlings + machine transplantation and cultivation, and ② direct sowing and cultivation. However, ② is carried out only in very limited areas and the increasing trend in the employment thereof has now levelled off, so most rice cultivation is based on ①, namely raising seedlings in boxes (young seedlings, older seedlings) and then machine transplantation thereof. The operations involved comprise (1) disinfection of the seed (2 days) → (2) soaking seed (7-10 days) → (3) forcing of sprouting (2 days) → (4) sowing/soil-covering/sowing of sprouted seed (2 days) → (5) raising seedlings (greening/hardening about 3 weeks) → (6) agrochemical treatment of the seedling boxes (during the period from several days prior to transplanting up to the day of transplantation), (7) machine transplanting. Such a schedule of operations is a considerable burden concentrated within a short period of time for the part-time farmer, and it is a burden too even for the specialist rice farmer. In particular, it has to be said that (1) seed disinfection and (6) application of the agrochemical granules or an agrochemical formulation derived therefrom to the seedling boxes is a troublesome operation. That is to say, (1) involves first preparing the appropriate amount of chemical liquid for the unhulled rice and then finally disposing of the used chemicals by land-fill at some location where they will cause no harm, with specially-developed commercial adsorption-treatment equipment

having to be used for this purpose since discharge into rivers is prohibited due to the strong toxicity towards fish. Furthermore, in the case of (6), when it is raining outside, the granular chemical applied to the seedling boxes gets soaked and forms lumps or it sticks to the hands, which is undesirable. Moreover, the granular chemical readily adheres to the stems and leaves of the wet seedlings, thereafter causing chemical 'burns' and impairing development. In the case of the sprinkling of a dilute liquid, problems arise such as the amount sprinkled per seedling box tending to be uneven.

[0004] (Conventional agrochemical-treated unhulled rice seed) In Japan in particular, agrochemical-treated unhulled rice is mainly unhulled rice subjected to a soaking treatment with chemicals to protect from Bakanae disease (a disease caused by Gibberella fujikuroi) and the rice shingare nematode (white tip nematode). Furthermore, there is also the treatment of unhulled rice seed with diluted concentrates of Prochloraz, Fenitrothion and Fenthion, etc, to provide the seed rice for cultivation using large-scale continuous equipment in agricultural experimental stations, agricultural cooperatives and the like. These kinds of agrochemical-treated unhulled rice seed are merely simple impregnated unhulled rice seed where diluted commercial emulsions of the respective components have been employed, so elution of the components by the water during subsequent seed soaking is unavoidable.

[0005]

[Means for Solving the Problem] The present invention comprises agrochemical-coated unhulled rice seed which

has been coated by means of an adhesive resin layer which contains agrochemical together with optionally-added surfactant and/or inorganic auxiliary; and a method for the production thereof. That is to say, the agrochemical-coated unhulled rice seed which constitutes the present invention is an agrochemical-coated unhulled rice seed produced by applying to unhulled rice seed a liquid mixture of an agrochemical component or agrochemical preparation, auxiliaries used for agrochemical preparations, and an aqueous emulsion of a water-insoluble adhesive resin. With this agrochemical-coated unhulled rice seed, even when seed soaking is carried out, elution of the agrochemical component into the water layer is inhibited and, furthermore, it is also possible to curtail the application of agrochemicals before and after machine transplantation.

[0006] (Properties of the Adhesive Resin) The adhesive resin layer on the agrochemical-coated unhulled rice seed of the present invention is formed by applying an adhesive resin liquid which contains agrochemical and optionally-added surfactant and/or inorganic auxiliary to the surface of the unhulled rice seed, followed by drying to produce a film coating. The resin component in the adhesive resin liquid used for the coating is a solid which is insoluble or only sparingly-soluble in water. Furthermore, the adhesive resin liquid containing this resin component has the form of an emulsion suspended in water, that is to say it is used in the form of an aqueous emulsion. It is also possible to use an adhesive resin powder but this is expensive. While not recommended, this powder can be used by mixing along with the unhulled rice seed, to achieve the objective of the present invention.

[0007] (The compatibility of the adhesive resin aqueous emulsion with the agrochemical component or agrochemical preparation, or the suspension stability thereof) As the adhesive component of the adhesive resin liquid for forming the coated resin layer in the present invention, there is used an adhesive resin aqueous emulsion (the so-called 'coating material') which has compatibility with, or shows dispersion stability in terms of, the agrochemical component or agrochemical preparation. This adhesive resin aqueous emulsion should mix well with the agrochemical component or agrochemical preparation (water-dispersible powder, emulsion, water-based flowable, oil-based [in the broad sense] flowable, capsule suspension or other such suspension, granular wettable agent or oil) employed, and with the surfactant and/or inorganic auxiliary, and, furthermore, it should be chemically stable and inert to the agrochemical component. The coating adhesive liquid in the present invention is chemically stable even when affixed to the unhulled rice seed and it does not bring about decomposition of the contained components, in particular the agrochemical component. Along with evaporation of the water component present in the coating liquid, the fine particles of dispersed resin component mutually interconnect and coalesce. In this way a film is formed, with the agrochemical fused or suspended in the coalesced material, and the seed is uniformly covered either continuously or, in certain cases, intermittently, for example in a dappled or spotted fashion. Due to this coating of water-insoluble resin film, the agrochemical component in the agrochemical-coated unhulled rice seed is not readily lost from the unhulled rice seed and so, as a result,

elution inhibition is achieved such that elution of the agrochemical component only takes place gradually.

[0008] (Examples of the adhesive resin) Synthetic adhesive resins are commercially available as aqueous emulsions and powders. A diverse range of such commercial products is available based on type of chemical structure and degree of polymerization, and these can also be used on their own or as mixtures. The synthetic adhesive resins which can be employed for the agrochemical-coated unhulled rice seed of the present invention are resins which are harmless to the rice plant, examples of which are vinyl acetate based copolymers such as copolymers of vinyl acetate plus acrylic monomers, VeoVa [vinyl esters of versatic acid which have outstanding properties and about the same strength as vinyl acetate; products developed by Shell: $R_1R_2R_3C$-$COOCH=CH_2$ (where R_1, R_2 and R_3 are lower alkyl groups)], ethylene, or ethylene and vinyl chloride. Furthermore, natural resins can also be used and, providing they can be produced as an aqueous emulsion of water-insoluble resin, they can be employed on their own or mixed with a synthetic resin. Moreover, the rubber latexes known by the name neoprene (SBR Latexes) can also be used on their own or as mixtures. The degree of polymerization of these water insoluble or sparingly-soluble adhesive resins will normally be sufficient for them to function normally as a coating material, and such that the adhesive resin layer formed is solid. Next, some specific examples of the aqueous emulsion are shown but there is no restriction to these.

[Tab.1]

(1) vinyl acetate/acrylic copolymer resin
(2) vinyl acetate/VeoVa copolymer resin
(3) vinyl acetate/maleate copolymer resin
(4) vinyl acetate/ethylene copolymer resin
(5) vinyl acetate/ethylene/vinyl chloride copolymer resin
(6) acrylic/styrene copolymer resin
(7) acrylic copolymer
(8) polyvinyl acetate

[0009] The amount of adhesive film-forming resin used for coating the agrochemical to the unhulled rice seed will differ according to the water solubility of the agrochemical. Where the solubility is 80-100 ppm, the amount is 30-50 g per 1 Kg of the unhulled rice seed; where it is 50 ppm the amount is 10-30 g per 1 Kg; and at solubilities below this an amount in the range 0.2 to 10 g per 1 Kg is preferred. However, there will be a balance in terms of the amount of agrochemical and so it is not possible to precisely specify the range of amount coated. (Note that the amount of adhesive resin coated per 1 Kg of the unhulled rice seed is based on the dry weight of adhesive resin aqueous emulsion.)

[0010] (Unhulled rice seed) The unhulled rice seed used in the agrochemical-coated unhulled rice seed of the present invention is a dry unhulled rice seed normally referred to as 'seed rice' and there are no particular restrictions on variety thereof, but there can be used rice seed which has undergone a grading/sorting procedure such as salt-water grading, or grading by a bulk systematic method using a coarse grader, debearder, seed cleaner, uniseed cleaner, uniflow separator and the like.

[0011] (Relation between the unhulled rice seed used and the amount of coated adhesive resin) Germination of the unhulled rice seed and seedling growth control are important conditions for machine transplanting, and grading of the purchased dry unhulled seed is carried out prior to the coating of the agrochemical. Seed is preferred which has undergone a process based on the systematic method using a coarse/rough grader (elimination of the rice koji, large size debris), a debearder, a seed cleaner (elimination of long-thick waste and grains still attached to stalks) and a uniflow separator (elimination of husked rice and split rice). Even graded rice which has passed through this process can be a source of uneven growth due to the presence of rice where the husk has been damaged by the rubbing together of grains of unhulled rice (this is unhulled rice where the husk readily tends to separate away to form husked rice). Such unhulled rice seed tends to germinate more rapidly compared to the normal seed and it grows erratically to form softer weaker rice seedlings. The coating of husk-damaged seed with a water-insoluble resin mitigates such problems. Normally, the coated amount of this adhesive resin will preferably lie in the range 2 to 100 g per 1 Kg of the unhulled rice. However, from the point of view of achieving a smooth process in terms of ① biological safety, ② a balance in the inhibition of elution during seed soaking, ③ interior sticking of the adhesive resin during operation of the coating apparatus, and ④ avoiding adhesion between seeds, the amount of adhesive resin applied is preferably from 2 to 50 g per 1 Kg of the unhulled rice.

[0012] (The agrochemicals coated onto the unhulled rice seed) As examples of the agrochemicals incorporated into the adhesive resin liquid in the case of the agrochemical-coated unhulled rice seed of the present invention, there are biocides, nematocides, insecticides and plant growth regulators. The agrochemicals used in the agrochemical-coated unhulled rice seed of the present invention need not just be a single type for an aforesaid application and there may also be used mixtures of two or more in optionally selected other applications. Specific examples of the aforesaid agrochemicals are now given, based on their general name and chemical name.

(Biocides) Coating is carried out with the appropriate chemical agents for eliminating Bakanae disease, goma (black spotted) leaf blight disease, rice blast disease (the above are caused by moulds), bacterial damping-off of the rice seedlings, bacterial blight of unhulled rice, brown streak disease and the like, occurring in the seedling boxes or in the rice plants growing in the paddies.

Specific examples: Triflumizole [chemical name: (E)-4-chloro-α,α,α-trifluoro-N-(1-imidazol-1-yl-2-propoxyethylidene)-o-toluidine], and Benomyl [chemical name: methyl-1-(butylcarbamoyl)-2-benzimidazole carbamate]

[0013] (Agent for protecting against rice shingare [white tip] nematode) Coating is carried out with an appropriate chemical agent for eliminating rice shingare nematode

Specific example: Fenthion (MPP) [chemical name: O,O-dimethyl-O-[3-methyl-4-(methylthio)phenyl]thiophosphate]

[0014] (Insecticides) Coating is carried out with appropriate chemical agents for eliminating the rice water weevil, rice leaf beetle, rice-plant weevil, green rice leaf hopper, small brown plant hopper, rice leaf miner, white-backed plant hopper, brown plant hopper, rice leaf roller and rice skipper, which are harmful insects following transplantation in the paddies.

Specific examples: As examples of agents for the elimination of rice water weevil and various types of leaf hopper, there are Benfuracarb [chemical name: ethyl N-[2,3-dihydro-2,2-dimethylbenzofuran-7-yloxycarbonyl-(methyl)aminothio]-N-isopropyl-β-alaninate]; and Fenthion (MPP)

[0015] (Plant growth regulators) Plant growth regulators (hereinafter referred to as plant regulators) include those which promote the germination of unhulled rice

Specific examples: Paclobutrazol [chemical name: 2-methyl-1-pyrimidin-5-yl-1-(4-trifluoromethylmethoxy-phenyl)propan-1-ol] and Forchlorfenuron [chemical name: 1-(2-chloro-4-pyridyl)-3-phenylurea]

[0016] The amount of agrochemical coated onto the unhulled rice seed is normally within a range not exceeding the amount applied per unit area against such insect pests and diseases.

[0017] (Type of surfactant) Nonionic surfactants are suitable as the surfactants added to the adhesive resin liquid. Amongst nonionic surfactants, the poly-oxyethylene adducts (addition products) are preferred.

The number of moles of added ethylene oxide lies in the range 6 to 22 and the HLB is preferably in the range 4 to 18. Sorbitan higher fatty acid esters, polyethylene glycol higher fatty acid esters and polyglyceryl higher fatty acid esters can also be used. Besides these, anionic surfactants may also be employed but care needs to be given to the use thereof in that instability may be brought about in terms of the aqueous emulsion of water-insoluble adhesive resin or unhulled rice components. Cationic surfactants cease to function as surfactants on drying and they can lead to chemical damage, so are undesirable.

[0018] To show the effects of the addition of a surfactant as described below, the usual content thereof when a surfactant is used is from 0.1 to 10 g per 1 Kg of the unhulled rice seed. It is possible not to include surfactant in the adhesive resin layer but because of the effects of surfactant addition, as described below, adding a surfactant is generally preferred.

[0019] In the case where an agrochemical preparation which already contains surfactant is employed, the amount of further surfactant added can be correspondingly reduced. When a commercial agrochemical emulsion or suspension, etc, is used, these will already contain surfactant so the addition of fresh surfactant may not be necessary or the amount may be reduced. Mixed agrochemical preparations are generally liquid preparations such as emulsions or flowables, and they normally contain surfactant, so it is necessary to adjust the amount of surfactant added based on the content thereof. In the case where the added agrochemical preparation is a wettable powder, a comparatively large

amount is added. A wettable powder comprises active component and a fine mineral powder and it will include chiefly a dispersant or suspension agent, but there is little emulsifying surfactant, so it is necessary to add for example surfactant of the type shown in the examples below. Added surfactant is important as an emulsifying material to serve as a stable emulsifier or suspension agent when coating the agrochemical component onto the unhulled rice seed. Furthermore, when carrying out the production of coated unhulled rice seed using a wettable powder as the agrochemical preparation, surfactant is effective in preventing the separation of the husk which is caused by the rubbing of the mineral component present and also in aiding the spread of the agrochemical at the unhulled rice surface. Again, mixed compositions of polyoxyethylene adducts enhance mutual affinity with the adhesive resin liquid composition and, furthermore, they can provide smooth controlled elution of agrochemical component. In addition, in the case of agrochemical preparations like Fenthion emulsion and Triflumizole emulsion, the aforesaid adducts aid the passage of the agrochemical component through the husk of the unhulled rice seed. Furthermore, the surfactant permeates from the exterior husk of the unhulled rice (the glume, etc) into the interior, along with the agrochemical. In the columnar cell walls of the unhulled rice husk epiderm, silica is deposited and the cells are swollen and hard, but in the fibrillar cells and the soft spongy tissue of the interior there are many spaces and pores are present. The coating liquid comprising a mixture of an aqueous emulsion of agrochemical-containing preparation and the synthetic resin aqueous emulsion passes through this structure, saturating the husk interior and reaching the space with the interior rice, where it is further

absorbed by the rice. The seed coat surrounding the interior rice is thin but even on contact with water it does not readily absorb water. However, a liquid containing surfactant passes through this barrier. Furthermore, where the insecticide or biocide component is a waxy or oily material at normal ambient temperatures, it readily reaches the endosperm. Such components are selected to be safe to the crop and, furthermore, to be active materials, so suitable amounts thereof function extremely effectively in terms of the germination and growth of the seeds.

[0020] (Specific examples of the surface active agents) Below, specific examples of the surface active agents are provided but there is no restriction to these.

[Tab.2]

(Nonionic Surfactants)
(1) polyoxyethylene octyl phenyl ether
(2) polyoxyethylene nonyl phenyl ether
(3) polyoxyethylene higher alkyl (C_{16}) ether
(4) polyoxyethylene higher alkyl (C_{11}) ether
(5) polyoxyethylene higher alkyl (C_8) ether
(6) polyoxyethylene sorbitan monooleate
(7) polyoxyethylene sorbitan monostearate
(8) polyoxyethylene sorbitan monolaurate
(9) sorbitan trioleate
(10) sorbitan monooleate
(11) sorbitan monostearate
(12) sorbitan monolaurate
(13) polyethylene glycol dioleate
(14) polyethylene glycol distearate
(15) polyethylene glycol dilaurate

(16) polyethylene glycol monooleate
(17) polyethylene glycol monostearate
(18) polyglyceryl fatty acid ester

[0021]

[Tab.3]

(Anionic surfactants)
(1) Alkali salts of higher alcohol sulphate esters
(2) Alkali salts of higher alkyl ether sulphate esters
(3) Alkali salts of alkylbenzene sulphonates (including the Ca salts)
(4) Alkali phosphate ester salts

[0022] (Inorganic auxiliaries) The inorganic auxiliaries added to the adhesive resin liquid are generally inorganic surface modifiers, opacifying materials, protective wall materials or bulking materials (pelleting agents) for the coated seed product. These inorganic auxiliaries are added to the adhesive resin liquid as a fine powder. Amongst such inorganic auxiliaries, those with a pH of 5-9 comprising either natural mineral materials or synthetic minerals (including fired materials) are preferred. Materials with a high adsorption capacity may well have secondary effects on the agrochemical (causing decomposition or inactivation thereof), so are not desirable. The amount of inorganic auxiliary contained in the adhesive resin liquid is normally from 0.1 to 20 g per 1 Kg of the unhulled rice seed. Where the agrochemical component is a powder and the amount coated is small, there may be no need to add inorganic auxiliary. While there are cases where no inorganic auxiliary is included in the adhesive

resin liquid, it is generally preferred that inorganic auxiliary be included.

(Specific examples of the inorganic auxiliaries) Specific examples of the inorganic auxiliaries added to the adhesive resin liquid are silky micaceous minerals, alumina, titanium oxide, Iriodin (titanium oxide coated mica), clay, talc, diatomaceous earth, kaolin, bentonite, illite, hallosite, pearlite, vermiculite, zeolite, calcium sulphate, calcium carbonate, calcium silicate, magnesium silicate, flowers of silica, active clay, acid clay, iron oxide and active carbon. In the case where the agrochemical preparation added to the adhesive resin liquid is an emulsion or suspension containing, besides the surfactant, an oily material, for example an efficacy enhancing oil agent, an oily material for component stabilization or a capsule forming agent, etc, this can be a cause of 'stickiness' at the surface of the agrochemical-coated unhulled rice seed of the present invention. This 'stickiness' is eliminated by the addition of an inorganic auxiliary and any 'feeling of dampness' at the surface of the agrochemical-coated unhulled rice seed is removed. However, in the case of a wettable powder where the agrochemical preparation added to the adhesive resin liquid already contains inorganic auxiliary, it may not be necessary to add any further inorganic auxiliary or the amount newly added may be reduced.

[0023] (Colouring matter) Colouring matter is not an essential structural component of the agrochemical-coated unhulled rice seed of the present invention but in the case of the production, sale, transportation, storage and use of the agrochemical-coated unhulled rice seed of the

present invention, a minimum amount of colouration is required for safety's sake, so that the seed is not employed either for food or for animal feed. An azo lake or insoluble azo compound is suitable as the colouring matter. These colouring materials are non-toxic to the unhulled rice seed and the amount added should be sufficient such that the rice can be identified and use for any other objective avoided.

[0024] The following are specific examples of the colouring matter.

(Azo lake compounds)

(1) Brilliant Carmine 6B (No. 15850)
(2) Lake Red C (No. 15585)

[0025] (Insoluble azo compounds)

(1) Pigment Red 112
(2) Pigment Yellow 74
(3) Pigment Blue 25

[0026] It is possible to produce the adhesive resin liquid containing agrochemical and, optionally, newly-added surfactant and/or inorganic auxiliary, which is used for forming the adhesive resin layer on the agrochemical-coated unhulled rice seed of the present invention by adding a suitably selected aforesaid agrochemical or agrochemical preparation and optionally-added aforesaid surfactant and/or inorganic auxiliary (plus colouring matter) to a suitably selected aforesaid adhesive resin liquid, and then thoroughly mixing these together. The order of addition of the various components added to the starting adhesive resin liquid is

not particularly restricted but it is preferred that they be added, while thoroughly mixing, in such a way that the physical state of the adhesive resin liquid, for example the emulsion state, is not damaged. This addition can, for example, be carried out by the method of dripping (adding dropwise) or pouring the agrochemical or agrochemical preparation in liquid or fine powder form, while stirring, into the adhesive resin liquid, which may or may not have been diluted with water. In such circumstances, the optional newly-added surfactant and/or inorganic auxiliary (plus colouring matter) may be introduced prior to the addition, during the addition or after the addition of the agrochemical or agrochemical preparation, or alternatively they may be added beforehand to the agrochemical preparation. The mixing temperature may be the normal exterior air temperature, for example the mixing can be carried out in the range 0 to 40°C, but the component addition is preferably carried out at a temperature such that the physical state of the adhesive resin liquid is not damaged but which permits thorough mixing together of the added agrochemical or agrochemical preparation with the adhesive resin liquid.

[0027] The adhesive resin liquid produced in this way is applied to the unhulled rice seed to produce the agrochemical-coated unhulled rice seed of the present invention. The method of application will be by a normally-used method. For example, drying is carried out while directly sprinkling or spraying the aforesaid adhesive resin liquid onto the stirred rice seed, or there is the method of dropping onto a rotating flat or undulating disc so that dispersal and drying take place. The temperature for forming the adhesive resin layer will be a temperature sufficiently high to bring about

evaporation of the water component which serves as the solvent in the adhesive resin liquid, but without having any adverse effects on the unhulled rice seed or the contained components. Normally, the temperature lies in the range from 20 to 70°C and preferably 20 to 50°C. The rate of stirring of the unhulled rice seed at the time of formation of the coated film from the adhesive resin liquid needs to be suitably adjusted so that there is no undesirable damage to the unhulled rice seed. In order to appropriately hasten the drying of the coated film of adhesive resin liquid, ordinary air or dry air may be forcibly passed into the equipment used for stirring the unhulled rice seed.

[0028] The following are specific examples of the equipment used for forming this adhesive resin layer:

(Production equipment) The production of the agrochemical-coated unhulled rice seed does not require specially restricted equipment but some equipment used in tests is described below. As examples of large-scale production equipment, there are the Nippon Sharyo (Co.) and Gustavsson type equipment.

[Tab.4]

Table 1 Examples of Experimental Equipment suitable for Seed Coating

Abbreviation	A	B	C
Maker and Model Type	Freund Corp. CF-360	Fuji Paudal Co. NQ-lab	Hans-Ulrich Hege, West Germany
System and Model No.	batch system	batch system	batch system HEGE-11
Container	chest type (cylinder bottom plate rotation type)		bowl type
Supply of Coating Liquid	sprayed towards the rice seed		liquid dripped onto rotating disc
Rotating Part	bottom plate		lower (1/2) concavity
Rate of Rotation rpm	about 250	about 400	about 2800
Seed Rotation and Flow	piles up towards the bottom of inner wall face and rolled		piles up on the upper internal wall face; twisted and rolled
Features	warm air drying possible		dropped onto the plate from the seed height position; forms a spray horizontally and flung to the sides by centrifugal force

[0029] Now, the present invention also encompasses agrochemical-coated unhulled rice seed with a plurality of adhesive resin layers, where there are two or more adhesive resin layers comprising layers of the same or different adhesive resins containing identical or different agrochemicals in the layers so that identical or different agrochemicals may be released at different times according to the particular application of the agrochemical-coated unhulled rice seed. In such circumstances, the two or more suitably selected adhesive resin liquids may be applied in a suitable order using the aforesaid usual coated film forming methods and

drying then carried out. For example, agrochemical for use after transplanting to the paddy may be included in a lower layer of adhesive resin and agrochemical for use prior to paddy transplanting may be included in an upper layer of adhesive resin. More specifically, there is the case where insecticide is present in the upper layer and biocide in the lower layer.

[0030] Explanation is now provided of the unexpected effects of the agrochemical-coated unhulled rice seed of the present invention, and the action thereof.

(By using unhulled rice seed which has been coated with agrochemical, it is possible to curtail seed disinfection and agrochemical application to the seedling boxes) In the cultivation of wetland rice in Japan, excluding non-specific conditions such as weather, etc, the factors governing the harvest are said to lie in the so-called seedling production operations, starting from selection of the seed rice density up to the machine transplantation. The steps in this process comprise ① seed rice disinfection, that is to say daubing the unhulled rice with disinfectant, soaking for 10 minutes to 24 hours with liquid formed by 100 to 1000 fold dilution of emulsifier, spray treatment of the diluted concentrate, ② soaking of the seed, ③ hastening of germination, ④ sowing of seed (seedling boxes), sowing of sprouted seed, ⑤ growing-on the seedlings, ⑥ treatment with granular agrochemical (applied to the seedling boxes somewhere between a few days before transplanting and the actual day of transplanting). From amongst these operations, those involving the troublesome operations of handling the agrochemical, weighing it out and applying it, that is to say ① and ⑥, can be omitted by using the

agrochemical-coated unhulled rice seed of the present invention.

[0031] (The necessity of seed soaking and the inhibition of component elution at the time of seed soaking) The operations comprising ② water soaking of the seed (about 4 days at 25°C with twice the amount of water compared to the seed) and ③ the hastening of germination/sprouting (2 days at 30°C) are essential steps for smooth germination, growth and seedling sorting, and the machine transplantation of the young seedlings. That is to say, they are essential to eliminate variations in the transplanting, by sorting according to germination and seedling establishment (height). In general, the seed rice disinfection carried out prior to the seed soaking comprises a short soak in a medium concentration of biocide/insecticide, a long soak at a low concentration or a high concentration spray treatment (using a seed disinfector) or daubing treatment, and, along with the water absorption in operations ② and ③, the seed rice is caused to swell and the disinfection and elimination of insects are said to be completed over this period. However, at this time there is considerable elution of the agrochemicals into the water layer. During this time, on account of the fine dirt and bacteria adhering to the unhulled rice seed and the eluted unhulled rice seed components, etc, the water gives off an unpleasant smell, so once every two days it is replaced by fresh water. The levels of component loss in such circumstances cannot be disregarded.

[0032] (Aqueous solubility of the agrochemical components and the inhibition of elution by the water-insoluble adhesive resin) The rate of elution of

agrochemical components by conventional soaking of agrochemical-coated unhulled rice essentially has a positive correlation to the solubility of the particular agrochemical in water. In the case where the agrochemical solubility in water is no more than 150 ppm, and in particular where it is no more than 100 ppm, if, as in the case of the present invention, the agrochemical component is mixed with a water-insoluble or sparingly-soluble adhesive resin liquid in an amount lying within a range such that the normal germination and growth of the seed rice is maintained, and then the mixture applied to the unhulled rice to form a resin layer, it is possible to inhibit the elution of the agrochemical component and reduce the aforesaid loss which occurs every time the water is replaced. If the agrochemical solubility in water is low, then naturally the elution rate is also low. For example, if the solubility is less than 10 ppm, then the elution rate is extremely low. Where the solubility is low in this way and, furthermore, the agrochemical component coated onto the unhulled rice has a solid powder form or it is a solid powder derived from a suspension, or again even where it is a liquid component and has been adsorbed onto a solid powder, at the time of soaking the agrochemical components are shed or washed-out from the surface of the unhulled rice. In such circumstances, in accordance with the present invention, when there is used a water-insoluble or sparingly water soluble adhesive resin liquid, it is possible to prevent such shedding or washing-out.

[0033] (The form of the agrochemical component used and the effect of the adhesive resin) The same agrochemical can be used in various preparation forms. Generally speaking, when the agrochemical component dissolves in an

organic solvent and is stable, it is prepared in the form of an emulsion but, depending on the objectives, it can also be used in the form of a wettable powder by absorption thereof onto an oil-absorbing powder. Moreover, an agrochemical component which is a solid soluble in organic solvents may sometimes be used as a wettable powder. Furthermore, where an agrochemical component is not soluble in either water or organic solvents but is stable in water, it can be used to prepare a suspension. It is useful to employ such wettable powders or suspensions as the agrochemical in the water-insoluble adhesive liquid in the present invention. When these wettable powders or suspensions are used as a mixture with the aqueous emulsion of synthetic resin to treat the unhulled rice seed, the seed husk forms a filter material for the solid components (the solid agrochemical or support, etc) or the powder on which a liquid agrochemical has been absorbed, causing the solids to remain at the surface. However, since the water-insoluble or sparingly water soluble adhesive resin coats the outside of these agrochemical components, the shedding or elution thereof is prevented. Where the agrochemical components are waxes or liquids which are insoluble in water or only sparingly soluble in water, and they have the form of an emulsion for use in the present invention, the washing-out of the agrochemicals is inhibited by the layer of water-insoluble or sparingly water soluble adhesive resin and so again the agrochemical-coated unhulled rice seed of the present invention is useful. However, if the adhesive is water soluble, when soaking in water is carried out there is elution of the adhesive and, furthermore, the agrochemical component coated at the unhulled rice surface is also eluted or shed into aqueous layer, so

elution inhibition is impossible. In addition, a water-soluble adhesive absorbs moisture from the atmosphere, causing the surface of the agrochemical-coated unhulled rice seed to become sticky, which is undesirable.

[0034] (Sticking of the adhesive resin layer to the unhulled rice husk and the permeation of the agrochemical components within the husk) In order to reduce the amount of agrochemical component lost and made ineffective in the soaking of the agrochemical-coated unhulled rice seed, it is desirable that the adhesive resin layer adheres closely to the unhulled rice husk structure. The surfactant within the adhesive resin layer helps to achieve such close adhesion. The present inventors have hypothesized the following phenomenon:- That is to say, the surfactant which has a surface tension reducing function leads the agrochemical component and the synthetic resin adhesive aqueous emulsion into the cells of the husk of the unhulled rice, reaching the interior rice wax layer and the endosperm, after which, along with the evaporation of the water component within the unhulled rice, the adhesive resin is affixed and an elution-inhibiting structure is formed. If the agrochemical contained in the water-insoluble adhesive resin layer is an agrochemical component forming such an elution-inhibiting structure, the effects of the agrochemical-coated unhulled rice seed of the present invention are further enhanced.

[0035] (Working of the agrochemical component coated onto the unhulled rice seed) The unhulled rice seed which has been coated with agrochemical component is subjected to soaking and hastening of germination, and the bulge bulges out, but during this time elution of the

agrochemical component into the water is inhibited by the coating of water-insoluble adhesive agent. The coated unhulled rice seed is then sown in the seedling boxes and growth takes place in a state of sufficient moisture and warmth. Over this period, the water-insoluble coated layer on the coated unhulled rice seed swells and the root region newly developed from the rice seed itself continues to grow with excellent growing strength along with the growth of young leaves, while agrochemical coated to the outside perimeter of what can be described as the seed itself is incorporated into the plant body along with moisture and fertilizer component. Moreover, the soil medium to which unhulled rice seed and agrochemical has been adsorbed protects the rice seedlings from insects and disease after machine transplantation to the paddy.

[0036] Above, there has been described the case where the agrochemical-coated unhulled rice seed of the present invention is used as the unhulled rice seed for transplanted wetland rice, but the agrochemical-coated unhulled rice seed of the present invention can also be employed for broadcast seeding in the form of a directly-sown type of agrochemical-coated unhulled rice seed, for example broadcast sowing from a height of a few metres or aerial broadcast seeding by plane.

[0037]

[Examples] The present invention is now explained in further detail by means of examples but the invention is not to be restricted by the description thereof.

(General factors relating to the examples)

(Notes) (1) The unhulled rice seed is referred to as the unhulled rice. (2) The liquid used for coating refers to the liquid composition not containing the agrochemical component. (3) The coating liquid refers to the composition containing agrochemical component and adhesive agent. (4) An impregnation liquid refers to an agrochemical preparation diluted with water. (5) The drying conditions are 1 hour at 40°C. (6) In the case of the amount of dry product obtained, there must be taken into account the evaporation of the equilibrium amount of water component possessed by the unhulled rice at the start, and so the amount of product obtained may be less than the weight introduced and is not fixed. (7) The coated amount of agrochemical component in the product (the agrochemical-coated unhulled rice seed) is expressed as the target value per 1 Kg. (8) % [percentage] in each case is on a weight basis.

[0038] Example 1: Triflumizole-coated unhulled rice

Coated unhulled rice employing a 30% wettable powder (commercial product) of the biocide Triflumizole [(E)-4-chloro-α,α,α-trifluoro-N-(1-imidazol-1-yl-2-propoxyethylidene)-o-toluidine] as the component preparation, together with a water-insoluble vinyl acetate/ethylene copolymer aqueous emulsion

[0039] [Experimental apparatus: (Table 1, apparatus C), its specifications and operation] Apparatus C is a laboratory scale model and the unhulled rice is introduced into the bowl-shaped container (7L). This container lies at the top of "a four-legged platform with a motor positioned longitudinally at the centre of the

interior" and it is connected to a longitudinal rotating shaft within the container. The rotating shaft projects into the centre of the bowl-shaped container, and is linked with a gear to the shaft of the motor of the four-legged platform beneath. The rotating shaft tip lies at 1/2 the depth of the bowl, and a disc of diameter 75 mm is fixed thereto. The peripheral edge of the disc has a gentle undulation like an open fan. A transparent lid is fitted to the container so that, during rotation, the rice seed does not fly out. In the centre of this lid is a small hole, and the coating liquid is allowed to drip down onto the disc at a rate of 2 drops per second using a plunger. The liquid droplets immediately form a spray and coat the unhulled seed which is scattered and rotated horizontally. This operation is halted at the completion of the dropwise addition of the coating liquid and normally takes no more than 10 minutes.

[0040] (Coating liquid: liquid composition containing the agrochemical) The following shows the formulation of the liquid used for coating, with which the Triflumizole is mixed for dripping onto the unhulled rice.

[Tab.5]

Table 2 The Liquid used for Coating

(1) colouring matter	Brilliant Carmine 6B (produced by Hoechst Japan Ltd)	0.3%
(2) Coating adhesive	Movinyl 181E (aqueous emulsion of vinyl acetate/ethylene copolymer resin: 55%; produced by Hoechst Gosei K.K.)	40.0
(3) Inorganic auxiliary	titanium dioxide (produced by the Junsei Chemical Co.)	1.0
(4) Water	distilled water	58.7

[0041] 11.25 g of the liquid used for coating shown in Table 2 and 0.5 g of Triflumizole wettable powder were mixed together to produce the coating liquid. 300 g of unhulled rice was introduced into the container and rotated, and the coating liquid added dropwise. The wet product formed was dried and there was obtained 298 g of coated unhulled rice containing 0.5 g of Triflumizole per 1 Kg of the unhulled rice.

[0042] Example 2: Fenthion coated unhulled rice

Coated unhulled rice employing as the component preparation a 50% emulsion of Fenthion [chemical name: O,O-dimethyl-O-[3-methyl-4-(methylthio)phenyl]thio-phosphate] which is used for the eradication of rice shingare nematode, together with water-insoluble vinyl acetate/ethylene copolymer resin aqueous emulsion:

0.09 g of commercial 50% Fenthion emulsion and 11.25 g of the liquid used for coating shown in Table 2 of Example 1 were mixed together, to produce the coating liquid. In the coating operation, 300 g of unhulled rice was introduced into the equipment used in Example 1 and rotated therein, and dropwise addition of the coating liquid carried out. The wet product formed was dried and there was obtained 296 g of coated unhulled rice containing 0.15 g of Fenthion per 1 Kg of the unhulled rice.

[0043] Example 3: Unhulled rice coated with a mixture of Triflumizole and Fenthion

Coated unhulled rice employing Triflumizole wettable powder and Fenthion emulsion as the component

preparations, together with water-insoluble vinyl acetate/ethylene copolymer resin aqueous emulsion:

0.5 g of Triflumizole wettable powder, 0.09 g of Fenthion emulsion and 11.1 g of the liquid used for coating shown in Table 2 of Example 1 were mixed together, to produce the coating liquid. In the coating operation, 300 g of unhulled rice was introduced into the equipment used in Example 1 and rotated therein, and dropwise addition of the coating liquid carried out. The wet product formed was dried and there was obtained 298.4 g of coated unhulled rice containing 0.5 g of Triflumizole and 0.15 g of Fenthion per 1 Kg of the unhulled rice.

[0044] Example 4: Unhulled rice coated with a mixture of Benfuracarb and Triflumizole

Mixed-coated unhulled rice coated with a liquid for coating which contained water-insoluble vinyl acetate/ethylene copolymer resin aqueous emulsion and using, as the component preparations, a 40% concentrate powder (trial product) of Benfuracarb [chemical name: ethyl N-[2,3-dihydro-2,2-dimethylbenzofuran-7-yloxycarbonyl(methyl)aminothio]-N-isopropyl-β-alaninate], which is an insecticide used for the eradication of rice water weevil, plus Triflumizole wettable powder as a biocide:

[0045]

[Tab.6]

Table 3 Composition of the Benfuracarb 40% concentrate powder

(1) 90% Benfuracarb stock material	45%
(2) propylene glycol	1
(3) Ca ligninsulphonate	4
(4) non-crystalline fine hydrated silicon oxide	50%

[0046]

[Tab.7]

Table 4: Composition of the liquid used for coating

① distilled water	71.3%
② Nonipol 85	1.3
③ titanium oxide	2.0
④ Brilliant Carmine 6B	0.4
⑤ Movinyl 181E	25.0

[0047] The coating liquid was prepared as follows as a smooth slurry. 7.5 g of the 40% Benfuracarb concentrate powder shown in Table 3 was slowly added to a liquid mixture of 0.5 g of the Triflumizole wettable powder, 8.5 g of distilled water and 20 g of the liquid used for coating shown in Table 4. In the preparation process, 300 g of unhulled rice was introduced into the equipment employed in Example 1 and rotated therein, and the coating liquid added dropwise. The wet product formed was dried and there was obtained 305 g of coated unhulled rice containing 0.5 g of Triflumizole and 10 g of Benfuracarb per 1 Kg of the unhulled rice.

[0048] Example 5: Triflumizole-coated unhulled rice

Coated unhulled rice employing Triflumizole wettable powder, together with water-insoluble acrylic/styrene copolymer resin aqueous emulsion:

[Tab.8]

Table 5 Composition of the liquid used for coating

(1) Movinyl DM-60 (acrylic/styrene copolymer resin) component content 50%, made by Hoechst Gosei	40.0%
(2) distilled water	60.0

[0049] 11.25 g of the liquid used for coating shown in Table 5 and 0.5 g of Triflumizole wettable powder were mixed together, to produce a coating liquid. In the preparation process, 300 g of unhulled rice was introduced into the equipment employed in Example 1 and rotated therein, and the coating liquid added dropwise. The wet product formed was dried and there was obtained 297 g of coated unhulled rice containing 0.5 g of Triflumizole per 1 Kg of the product.

[0050] Example 6: Triflumizole-coated unhulled rice

Coated unhulled rice employing 15% Triflumizole emulsion as the component preparation, together with a water-insoluble acrylic copolymer resin aqueous emulsion:

[Tab.9]

Table 6 Composition of the liquid used for coating

(1) Movinyl LP3600 (acrylic copolymer resin) component content 50%, made by Hoechst Gosei	40.0%
(2) distilled water	60.0

[0051] 11.25 g of the liquid used for coating shown in Table 6 and 1 g of Triflumizole emulsion were mixed together to produce a coating liquid. In the preparation process, 300 g of unhulled rice was introduced into the equipment employed in Example 1 and rotated therein, and the coating liquid added dropwise. The wet product formed was dried and there was obtained 297 g of coated unhulled rice containing 0.5 g of Triflumizole per 1 Kg of the product.

[0052] Example 7: Paclobutrazol-coated unhulled rice

Coated rice employing vinyl acetate/ethylene copolymer resin:

[Tab.10]

Table 7: Composition of the liquid used for coating

(1) Movinyl 181E (55%)	36.0%
(2) distilled water	64.0

12 g of the liquid used for coating shown in Table 7 and 1 g of Paclobutrazol (powder containing 90% of finely ground component along with clay) were mixed together to produce a coating liquid. 300 g of unhulled rice was introduced into the equipment employed in Example 1 and rotated therein, and the coating liquid added dropwise.

The wet product formed was allowed to dry naturally and there was obtained 297 g of coated unhulled rice containing 3 g of Paclobutrazol per 1 Kg of the product.

[0053] Comparative Example 1: Impregnated unhulled rice obtained by soaking in an impregnating liquid produced by mixing Fenthion emulsion and distilled water

0.09 g of Fenthion emulsion and 11.25 g of distilled water were mixed together to produce the impregnating liquid. With 300 g of unhulled rice introduced into the equipment used in Example 1 and rotated therein, this impregnation liquid was added dropwise. The wet product formed was dried and there was obtained 296 g of impregnated unhulled rice containing 0.15 g of Fenthion per 1 Kg of the unhulled rice.

[0054] Comparative Example 2: Benfuracarb and Triflumizole mixed-coated unhulled rice

Coated unhulled rice based on the water-soluble adhesive agent PVA (polyvinyl alcohol)

[Tab.11]

Table 8 Composition of the liquid used for coating

(1) distilled water	88.3%
(2) Nonipol 85	1.3
(3) Brilliant Carmine 6B	0.4
(4) polyvinyl alcohol (Poval 205S: Kuraray)	10.0

7.5 g of Benfuracarb 40% concentrate powder was slowly added to a mixture of 0.5 g of Triflumizole wettable

powder, 8.5 g of distilled water and 20 g of the liquid used for coating shown in Table 8, to produce a coating liquid. In the preparation process, 300 g of unhulled rice was introduced into the equipment employed in Example 1 and rotated therein, and the coating liquid added dropwise. The wet product formed was dried and there was obtained 306 g of coated unhulled rice containing 0.5 g of Triflumizole and 10 g of Benfuracarb per 1 Kg of the product.

[0055] Comparative Example 3: Triflumizole-impregnated unhulled rice

Impregnated unhulled rice employing Triflumizole as the component preparation:

1 g of 15% Triflumizole emulsion and 11.25 g of distilled water were mixed together to produce an impregnation liquid. In the preparation process, 300 g of unhulled rice was introduced into the equipment employed in Example 1 and rotated therein, and the impregnation liquid added dropwise. The wet product formed was dried and there was obtained 297 g of coated unhulled rice containing 0.5 g of Triflumizole per 1 Kg of the product.

[0056] Next, a comparison was made of the elution inhibition effects by measuring the levels of elution in water of the preparations produced in the examples and related comparative examples above.

Experimental Example 1: Elution test with the (Fenthion/impregnated or coated unhulled rice)

(1) Elution test conditions: 80 g of sample was introduced into a 300 ml beaker and 160 g of water added, then a lid placed thereon and the beaker kept at 25°C. After 24 hours, the entire amount of water was replaced with 160 g of fresh water. The water removed was used as an analytical sample. After a further 24 hours, the entire amount of water was poured off to give a second sample for analysis. The same procedure was repeated to give 5 samples for analysis.

(2) Analysis conditions: A part of the test water sample was taken and partitioning carried out with dichloromethane and, after concentrating, drying-up was performed and the sample made up to a constant volume with acetone. Quantitative analysis was then performed with a gas chromatograph (NP-FID) equipped with a capillary column using a thin film of methyl silicone.

[0057

[Tab.12]

(3) Measurement results (Fenthion water solubility = 55 ppm) 1) Elution % = (amount dissolved in water/amount impregnated in or coated onto the unhulled rice) × 100 2) Explanation of the coating materials used in the examples and comparative examples Example 2: water-insoluble vinyl acetate/ethylene copolymer, Movinyl 181E = abbreviated to EVA Example 3: same as in Example 2 (but while used as a mixture with Triflumizole, only the Fenthion was measured) Comparative Example 1: no coating liquid

[0058] 3) Measurement results

[Tab.13]

Number of Days of Seed Soaking (times water collected)	Example 2	Example 3	Comp.Ex.1
	EVA coating Fenthion emulsion alone	EVA coating liquid, mixture of Fenthion emulsion and Triflumizole wettable powder	(impregnated unhulled rice) Fenthion emulsion alone
1	2.9%	3.3%	7.3%
2	3.3	3.4	8.9
3	3.6	4.2	7.7
4	3.2	3.4	6.3
5	2.7	3.0	5.1
Total	15.7	17.3	35.3

In the case of the unhulled rice coated by means of a vinyl acetate/ethylene copolymer in Example 2 and Example 3, the elution of the Fenthion into the water layer was inhibited.

[0059] Experimental Example 2: Elution test with (unhulled rice coated with a mixture of Benfuracarb and Triflumizole)

Note: This is a comparison of coating agents

The elution test conditions were the same as in Experimental Example 1, and the analysis conditions were as follows. A part of the test water sample was taken and partitioning carried out with dichloromethane and, after concentrating, drying-up was performed and the sample made up to a constant volume with acetone. Quantitative analysis was then performed by means of a gas chromatograph equipped with a NP-FID detector. The

column was a glass column of length 1 m and internal diameter 2 mm, and as packing there was used 2% silicone OV-210 + 1.5% OV-17/Chromosorb W (HP) 100-120 mesh.

[0060] The measurement results are shown below. (Reference value: water solubility of Benfuracarb = 8 ppm)

[Tab.14]

(Notes to Table below)

Elution % = (amount dissolved in water/amount coated onto the unhulled rice) × 100

Coating material abbreviations used

Example 4: ethylene/vinyl acetate = EVA

Comp.Ex.2: polyvinyl alcohol = PVA

Measurement Results (Measurement of Benfuracarb alone)

Number of Days of Seed Soaking (times water collected)	Example 4	Comparative Example 2
	EVA coating	PVA coating
	mixture of Benfuracarb concentrate powder and Triflumizole wettable powder	
1	0.5%	30.5%
2	0.6	19.2
3	0.4	8.3
4	1.2	5.0
5	2.0	3.2
Total	4.7	66.2

In the case of Comparative Example 2, after 10 minutes the coated film dissolved and red colouring matter was dispersed in the water. After 2 days, there was shedding of the wettable powder and the white concentrate powder, and the unhulled rice was almost completely exposed. However, the EVA coating held the Benfuracarb and Triflumizole components and prevented loss thereof.

[0061] Experimental Example 3: Comparative elution test with (Triflumizole emulsion coated unhulled rice or impregnated unhulled rice)

Note: Comparison of the presence or absence of a coating

The elution test conditions were the same as in Experimental Example 1, and the analysis conditions were as follows. A part of the test water sample was taken and partitioning carried out with dichloromethane and, after concentrating, drying-up was performed and the sample made up to a constant volume with acetonitrile. After filtering with a 0.2 μ Teflon disposable filter, quantitative analysis was carried out using a high performance liquid chromatograph equipped with a UV absorption detector. The separation tube was a stainless steel tube of length 25 cm and internal diameter 4.6 mm, and as the packing there was used silica gel with octadecylsilane chemically bonded thereto.

[0062] The measurement results are shown below. (Reference value: water solubility of Triflumizole = 12.5 ppm)

[Tab.15]

(Notes to Table below) Elution % = (amount dissolved in water/amount coated onto the unhulled rice) × 100 Coating material abbreviations used Example 6: acrylic copolymer resin = ACP Comparative Example 3: impregnated (no coating material)

Measurement Results

Number of Days of Seed Soaking (times water collected)	Example 6	Comparative Example 3
	ACP coated	Impregnated Seed
	Triflumizole emulsion alone	
1	0.7%	1.5%
2	0.8	1.4
3	0.6	1.7
4	0.7	1.6
5	0.8	1.8
Total	3.6	8.0

The "ACP coated, i.e. acrylic copolymer resin coated, unhulled rice" of Example 6 showed suppressed elution when compared to the impregnated unhulled rice (no coating material) of Comparative Example 3.

[0063] Cultivation Example 1: Insecticidal test of (unhulled rice coated with a mixture of Benfuracarb and Triflumizole)

Cultivation was carried out by performing seed soaking, germination, seed planting, seedling growth and transplanting, starting with the mixed-coated unhulled rice from Example 4, and a comparison was made of the insecticidal effects with those in the case where the same component was applied to the seedling boxes in the usual way.

(1) Seed soaking → transplanting operations

160 g of the coated unhulled rice seed was placed in a container and twice the amount of water added, after which the rice seed was left for 4 days at 25°C. Over this period, the water was replaced three times. After leaving for 2 days in a germinator (29°C), the seed was planted in seedling boxes in which seedling growth mats

had been laid, covered with soil, and transferred to a greenhouse where growth was carried out by the usual method. After 20 days, transplantation was carried out. Untreated rice seed (strictly speaking this was the Triflumizole-coated unhulled rice from Example 1) was subjected to the same procedure and transplanting carried out. Directly prior to the transplanting, there was applied 32 g, per seedling box, of Oncol granular 5 (Ohtsuka Chemical Industrial Co. product name, 5% granular Benfuracarb) as the test reagent.

[0064]

[Tab.16]

(2) Test sections and cultivation control 1) cultivation area (1 section) = 3.4 m^2 (5 rows × 15 plants) 2) herbicide application ① 3.5 g/m^2 of Kusakarin 25 granular material (made by Sankyo) 5 days after transplanting ② 3.0 g/m^2 of Hinocloa granular material (made by Japan Bayer) 9 days after transplanting 3) fertilizer application: 4.0 g/m^2 of Chiyoda 550 (made by Nissan Chemical Ind.) 9 days after transplanting (3) Survey method and results (rice water weevil) 1) A survey was carried out of 20 plants per section for the extent of damage by the adult insect pests 2) Damage evaluation groups A: number of plants with 91% or more leaf damage B: number with 61-90% C: number with 31-60% D: number with no more than 30% E: no leaf damage

[0065]

[Tab.17]

(Notes to Table below)

3) degree of damage =

$$\frac{4 \times A + 3 \times B + 2 \times C + 1 \times D}{4 \times \text{number of plants surveyed}} \times 100$$

4) Survey results (days = days following transplanting)
Agent 1 = jointly employed with Triflumizole
Agent 2 = only Triflumizole, contains no insecticide, so corresponds to an untreated group

[0066]

[Tab.18]

Agent	Test Material	Amount of Agent	Adult Insect Damage		
			after 16 days	after 22 days	after 29 days
1	Example 4	40 g (*1)	3.2	2.1	2.6
2	Example 1	-	19.6	20.8	18.7
3	granular Oncol 5	40 (*2)	2.9	1.9	2.3

*1 based on 4 Kg of sown seed per 10a (ai 10 g/Kg unhulled rice) × 4 → 40g

*2 based on transplanting of 25 boxes per 10a (32 g × 0.05 × 25) → 40g

[0067]

[Effects of the Invention] In the case of unhulled rice seed which has been coated with the same type and, at most, the same amount of agrochemical component as that used to treat the rice seedling boxes, and in some cases the same type and, at most, the same amount of agrochemical used to treat the paddies before or after transplantation of the rice seedlings, and where said agrochemical component has been mixed beforehand with a water-insoluble adhesive resin aqueous emulsion, when the

seedlings are transplanted to the paddy following seed soaking, sowing and seedling growth, the efficacy of the agrochemical component is maintained for the time required for the objectives of the application of the particular chemical to be realized, for example over at least 1 month. This is because agrochemical component is not lost during the seed soaking, but rather a sustained elution thereof is achieved. As a result, it is possible to omit application of agrochemical to the seedling boxes prior to transplantation and application to the paddies prior or post transplantation. Furthermore, it becomes possible to use the agrochemical-coated unhulled rice seed for direct sowing, with the effects of the agrochemical being manifested at the appropriate time.

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